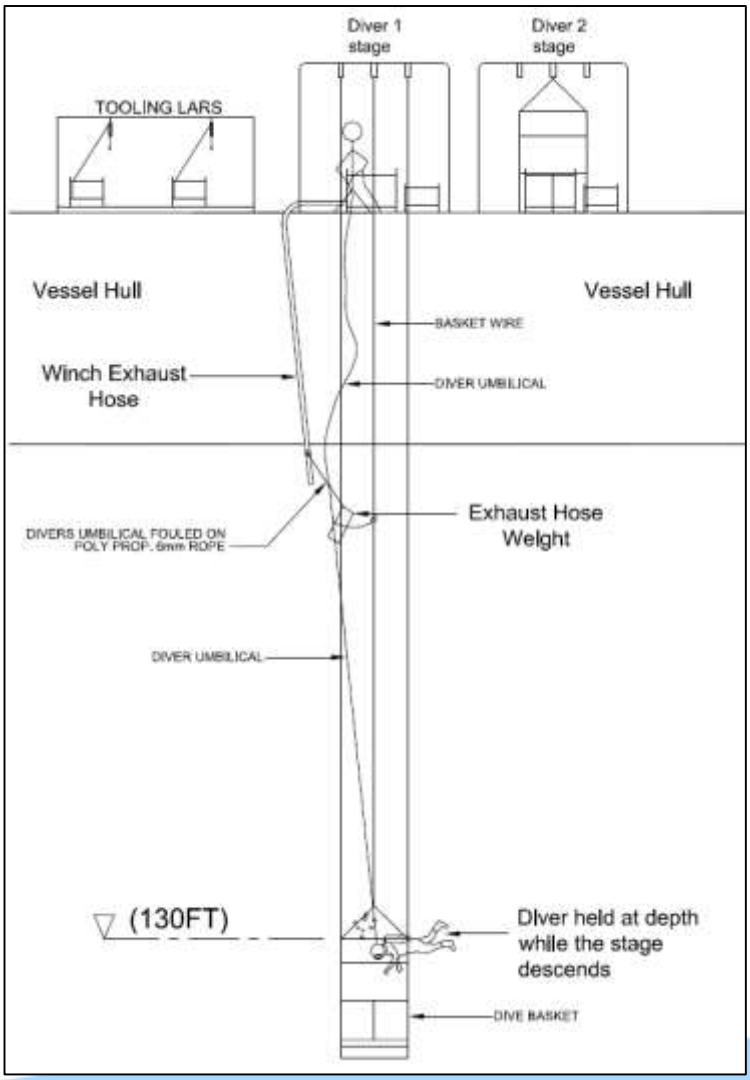
IMCA Safety Flash 01/16

January 2016

These three incidents are all diving-related incidents reported to IMCA in late Q4 2015.

1 High Potential Near Miss: Failure of Both Divers Breathing Air Supply & Dive Stage Recovery Winch

A member has reported a near miss incident in which a diver lost his breathing air supply and at the same time there was a failure of a dive stage recovery winch. The incident occurred on a Dynamic Positioning (DP) Diving Support Vessel (DSV) when a surface orientated air dive was planned for a depth of 160fsw. The dive stage was to be located at 130fsw. For reducing the noise exposure on deck, the LARS (Launch and Recovery System) air winch exhaust hose had been positioned in the water at the side of the vessel, close to where the diver 1 basket entered the water. A weight was attached by way of a lanyard at the hose end to prevent flailing while the winch was being operated (see diagram).



Whilst the diver was in the stage travelling to 130fsw, the running line connecting the umbilical to the stage wire became entangled with the winch exhaust hose weight. This entanglement was responsible for:

- Kinking of umbilical gas & pneumo hoses with subsequent loss of air supply to the diver;
- Kinking of the winch exhaust hose and subsequent failure of the winch;
- Prevention of free pay-out of the umbilical giving rise to the diver being held in position in the water column whilst the stage continued to descend.

The diver went immediately onto his emergency gas supply (bail-out cylinder). The diver was pulled to the roof of the stage onto his side which limited his access to the basket emergency air cylinder and he was unable to turn the supply on. The winch operator engaged the clump weight winch and was able to bring the basket up which caused the restriction to loosen allowing the main supply of gas to return to the diver. The dive was discontinued and the diver was returned to the surface safely. He was unharmed and there was no damage to equipment.

The incident had high potential as there could have been severe injury to the diver.

Our member investigation noted the following:

The most probable immediate cause was a combination of sea state and thruster wash which caused the

suspended exhaust hose and weight to "wander" more than usual. This in turn led to the entanglement of the weight with the carabiner:

- Should a situation occur in which the winch's air motor exhaust (of discharged pressurised air) is restricted or prevented from flowing freely through the control valves exhaust port, this condition will cause the air motor to slow to a stall, ceasing all rotation and operation. This is commonly referred to as "choking" the exhaust and is to be avoided in all cases as it will dramatically affect the performance of the air motor. The motor enters a "stall condition" as the inlet and discharge pressure balance against each other and the motor ceases rotating.

The following went right:

- The diver went immediately onto his emergency gas supply (bail-out cylinder);
- The team reacted in a calm and professional manner – no panic;
- Safe resolution of a complicated and dangerous situation was made in a matter of minutes;
- The black box recording was available and captured key elements of the incident for review and historical purposes.

The following immediate corrective actions were taken:

- "Safety Stand Down" with the entire diving team to discuss the incident;
- Winch hoses were removed from the proximity of the diving stage to eliminate the threat of entanglement;
- The weight keeping the exhaust hose submerged was secured directly to the hose end rather than by a length of rope, which had been instrumental in the fouling of the lines;
- Update of risk assessment for the positioning of equipment on deck - to include and reflect the situation that occurred;
- Diving umbilical was removed from service and pressure tested by the offshore technicians and checked for any defects;
- Review of deck risk assessment to incorporate the findings of the incident.

In the longer term our member aimed to:

- Eliminate the use of in water hoses;
- Install silencers directly on the winches.

Members may wish to refer to the following incidents (search words: *restricted, air supply, umbilical*):

- IMCA SF 15/08 – Incident 4 – *Near miss incident involving a diver's umbilical*
- IMCA SF 03/09 – Incident 2 – *Dive bell gas loss during internal bell checks*
- IMCA SF 15/09 – Incident 1 – *Trapped diver umbilical incident resulting in diver fatality.*

2 Injuries Due To Failure of Divers Emergency Gas Cylinder – Use of Incompatible Threads

An International Association of Oil & Gas Producers (IOGP) member has passed to IMCA for circulation to members an incident in which a pillar valve forcefully parted from a High Pressure (HP) cylinder filled with 180 bar of compressed air. The incident occurred on board a DSV (Diving Support Vessel) whilst divers prepared for a dive and were putting on their diving suits. As a result of the failure, five divers were injured as the parted valve flew off the cylinder.

A pillar valve or cylinder valve is the point at which the cylinder connects to the diving regulator. The purpose of the pillar valve is to control gas flow to and from the cylinder. The neck of the cylinder is internally threaded to fit a cylinder valve. Parallel threads are made to several standards and the most common standards are:

- M25x2 parallel thread, sealed by an O-ring;
- M18x1.5 parallel thread, sealed by an O-ring;
- 3/4"x14 BSP parallel thread, with a 55° Whitworth thread form;
- 3/4"x14 NGS (NPSM) parallel thread, sealed by an O-ring;
- 3/4"x16 UNF, sealed by an O-ring.

All these parallel threads are very similar but not compatible, as pitch, pitch diameter and thread forms are different.

The following points were noted:

- Investigation is still ongoing but preliminary assessment has confirmed that the inner thread on the HP cylinder was not compatible with the outer thread of the pillar valve;
- The HP gas cylinder inner thread was an M25x2 parallel thread, and the outer thread on the pillar valve was a 3/4"x14 BSP parallel thread (Whitworth);
- How the incompatible valve and HP gas cylinders came to be used together is still being investigated.

The following lessons were learnt:

The incompatibility of the valve thread and HP cylinder thread led to a serious incident. It is therefore of great importance that all diving contractors perform an immediate check to confirm the compatibility of the HP gas cylinders and valve threads in use at their operations. They should also clearly mark and register both HP gas cylinders and valves separately, so that compatibility can be verified and assured.

Fig 1: Permanent markings on top of air cylinder with thread specs: M25x2 - ISO

Fig 2: Example of pillar valve with 3/4" BSP parallel thread and no markings or thread specs

The following actions were suggested:

- Check HP gas cylinder threads and pillar valve threads for compatibility, ensuring that auditable evidence is made available;
- Mark the cylinder thread size for all HP cylinders – mark the thread size for all pillar valves, applying a unique identification that will be permanently visible and traceable;
- Have a working procedure and instruction in place that includes the verification of the compatibility of both the pillar valves and HP gas cylinders;
- Include compliance with this working procedure in the DESIGN audits which validate the 6 monthly internal and external inspections of HP gas cylinders;
- Include the HP gas cylinder and pillar valve identification numbers in the 6 monthly inspection certificates.

Members may wish to refer to the following incidents (search words: *pillar):*

- IMCA SF 02/04 – Incident 2 – *Near-miss involving bail-out bottle pillar valve;*
- IMCA SF 12/09 – Incident 1 – *Pillar valve failure;*
- IMCA SF 18/13 – Incident 4 – *High potential near miss - incompatible pillar valve assembly;*
- IMCA SF 19/14 – Incident 1 – *Injuries due to failure of diver's emergency gas cylinder.*

3 High Potential Near Miss: Poor O2 Content in Supplied Air - Diver Temporarily Lost Consciousness

A member has reported an incident in which a diver lost consciousness temporarily while getting ready to dive, due to the intake of low oxygen content in the Breathing Air Quad supply. The incident occurred during air diving work from a diving support vessel while the diver was still on board the vessel, beside the dive stage. It happened when the diver had his dive helmet locked on and the initial breathing air supply from the compressor was switched over to air quad supply to the diver. Prior to that, air from the diving compressor supply was run to perform the system check and testing for pre-dive checks.

After about 40 seconds of breathing from the Breathing Air Quad, while the diver was waiting for the clump weight to be lowered and was standing on deck beside the diving basket, he was observed to be disoriented and his body started to lose control. The tenders noticed the divers awkward position as he was about to collapse and responded swiftly to hold him and immediately assist to open the diving helmet and undress him.

The diver immediately regained consciousness and was given oxygen from the stand-by medical O2 cylinder as a precautionary measure. He was then assisted and walked to the vessel clinic for a check-up. The medic examined and observed him for about half an hour and he was found to be in good condition, discharged and advised to rest. The diver returned to normal diving routine on his next shift and resumed his diving rotation until completion of the project.

The Breathing Air Quads were immediately isolated after the incident. An investigation was conducted to determine the causes of the event. The following was noted:

- The Breathing Air Quads had been procured from a 3rd party licensed and approved vendor which had been used in the past;
- The gas content was tested for any contamination and the result was negative;
- The oxygen level in the Breathing Air Quads was tested on three occasions internally and by a 3rd party and it was confirmed that it was below the standard Breathing Air requirement (testing results showed around 3% Oxygen content);
- The quad had arrived with a certificate stating "Breathing Air Quality", but it was noted that the quad had N_2 (Nitrogen) stamped on its bottles which had recently been painted over;
- The oxygen analyser on the control panel did not alarm during the switch over from compressor supply to quads supply, most likely due to the long piping to the analyser and low flow rate;
- The immediate response by the diver's tender to remove the diver's helmet was noted as positive and correct;
- An immediate circular was sent to all diving worksites to conduct tests on all Breathing Air Quads confirming their oxygen levels. No oxygen deficiency level was reported from other sites.

The following lessons were learnt:

- Procedures for Quality Assurance Check on 3rd party supplied breathing air quads should be revised and improved;
- Air Diving Manual to be revised to include revision of the pre-dive checklist to cater for the complete draining of all remaining gas in piping leading to the analyser before a new supply is introduced.

Members may wish to refer to the following incidents (search words: *gas, quad*):

- IMCA SF 01/06 – Incident 1 – *Breathing gas contamination;*
- IMCA SF 06/12 – Incident 2 – *Failure to follow gas quad procedures;*
- IMCA SF 08/13 – Incident 1 – *Substandard nitrogen quads delivered to shipyard.*